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Saugus, Massachusetts Refuse Energy Systems Company Project

Brown, Vence and Associates
San Francisco, CA

Prepared for

California State Solid Waste Management Board
Sacramento

May 1981

U.S. Department of Commerce
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SAUGUS, MASSACHUSETTS
REFUSE ENERGY SYSTEMS COMPANY PROJECT

TECHNICAL BULLETIN

May, 1981

Prepared for:

STATE SOLID WASTE MANAGEMENT BOARD
State of California - The Resources Agency
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This technical bulletin is one of a series of reports presenting information gathered in visits to resource recovery facilities around the United States. This study effort has been sponsored by the California State Solid Waste Management Board (CSSWMB). As a number of California resource recovery facilities approach the implementation stage, the CSSWMB has recognized the need to learn from existing projects. In late 1980, five sites were chosen and visited by staff members of Brown, Vence and Associates, consultants to the CSSWMB. These sites included both small and large scale facilities, a number of differing technologies, and projects in varying stages of implementation or operation. The subject of this technical bulletin is the RESCO waste-to-energy project in Saugus, Massachusetts.

KEYWORDS: *Solid waste management, *Saugus(Massachusetts), *Refuse derived fuels.

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PREFACE

This technical bulletin is one of a series of reports presenting information gathered in visits to resource recovery facilities around the United States. This study effort has been sponsored by the California State Solid Waste Management Board (CSSWMB). As a number of California resource recovery facilities approach the implementation stage, the CSSWMB has recognized the need to learn from existing projects. In late 1980, five sites were chosen and visited by staff members of Brown, Vence and Associates, consultants to the CSSWMB. These sites included both small and large scale facilities, a number of differing technologies, and projects in varying stages of implementation or operation. The five sites were:

- Auburn, Maine
- Duluth, Minnesota
- Madison, Wisconsin
- Saugus, Massachusetts
- Akron, Ohio

The subject of this technical bulletin is the RESCO waste-to-energy project in Saugus, Massachusetts.

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INTRODUCTION

The Refuse Energy Systems Company (RESCO) plant, located in Saugus, Massachusetts, is presently receiving more than 1,150 tons per day (TPD), averaged over seven days per week, of municipal solid waste from Saugus and nearby communities. RESCO, which designed, built, and now operates the facility under a lease arrangement with the Town of Saugus, is a joint venture of Wheelabrator-Frye, Inc., and De Matteo Construction Company, the former landfill operator in Saugus. Title to the facility is held by the Town of Saugus. The plant burns unprocessed municipal solid waste (MSW) in von Roll waterwall incinerators, producing up to 370,000 lb/hr of superheated steam which is piped to a General Electric turbine manufacturing works across the Saugus River in Lynn, Massachusetts. RESCO has operated continuously since 1975, and, after substantial early investment in shakedown and modifications, is reportedly earning a profit.

The Town of Saugus is a suburb of Boston, located about ten miles northeast of downtown Boston, where the Saugus River empties into Massachusetts Bay (see Figure i-1). Saugus and twelve other metropolitan Boston municipalities supply solid waste to the RESCO plant under long-term contracts. Two districts of the City of Boston deliver refuse under short-term agreements. The RESCO plant serves a population of 750,000.

The RESCO project is noteworthy as a reliable waste-to-energy facility. In the past two years, each of the two boilers has been available more than 75% of the time; of the downtime, 85% has been scheduled, 15% unscheduled. The plant's reliability can be attributed to the relative simplicity of its technology and to RESCO's willingness to provide time and capital to work through some early problems.

Total capitalization of the RESCO project has exceeded $51 million. Ten million dollars in original equity, half from each RESCO partner, plus $30 million in industrial revenue bonds issued by the Town of Saugus, financed design and construction costs, which were estimated in the bond prospectus to be $38.3 million. In addition, since 1975, RESCO owners have contributed at least an additional $11 million for equipment improvements, bond reserve funding, and other working capital and start-up costs. The financing of the RESCO project was a somewhat complicated arrangement. The Town of Saugus has title to the plant and provided $30 million in tax-exempt financing. RESCO leases the plant from the Town, and receives the tax benefits of ownership. When the bonds are paid, Saugus must sell the plant to RESCO for $1.

The two principal sources of revenue for the project are tipping fees, which currently average about $16 per ton, and steam sales to General Electric, which pays its avoided costs for fuel oil less a 10% discount. Steam revenues are the net of high-pressure steam supplied to GE minus return waste steam, electricity, and fuel oil, all three of which GE provides to RESCO.

Current plant operating and maintenance expenses fall in the range from $10.50 to $11.50 per ton. These figures do not include the costs of residue disposal, water, and property taxes, nor do they include what RESCO pays for the forms of energy it receives from GE.

The order of events in which RESCO procured its waste-to-energy facility was somewhat unusual. A critical refuse disposal problem existed: from 1967 to 1971 the DeMatteo regional landfill in Saugus remained open only because a court order prevented the Saugus Board of Health from closing it for public health reasons. This landfill was the only available disposal site for nine municipalities in the area. RESCO began construction of the Saugus facility before it arranged bond financing, secured a waste supply, or obtained environmental permits. RESCO was willing to assume these risks because it was apparent that the plant offered the only solution to the disposal crisis.

Table i-1 presents important facts about the Saugus project.

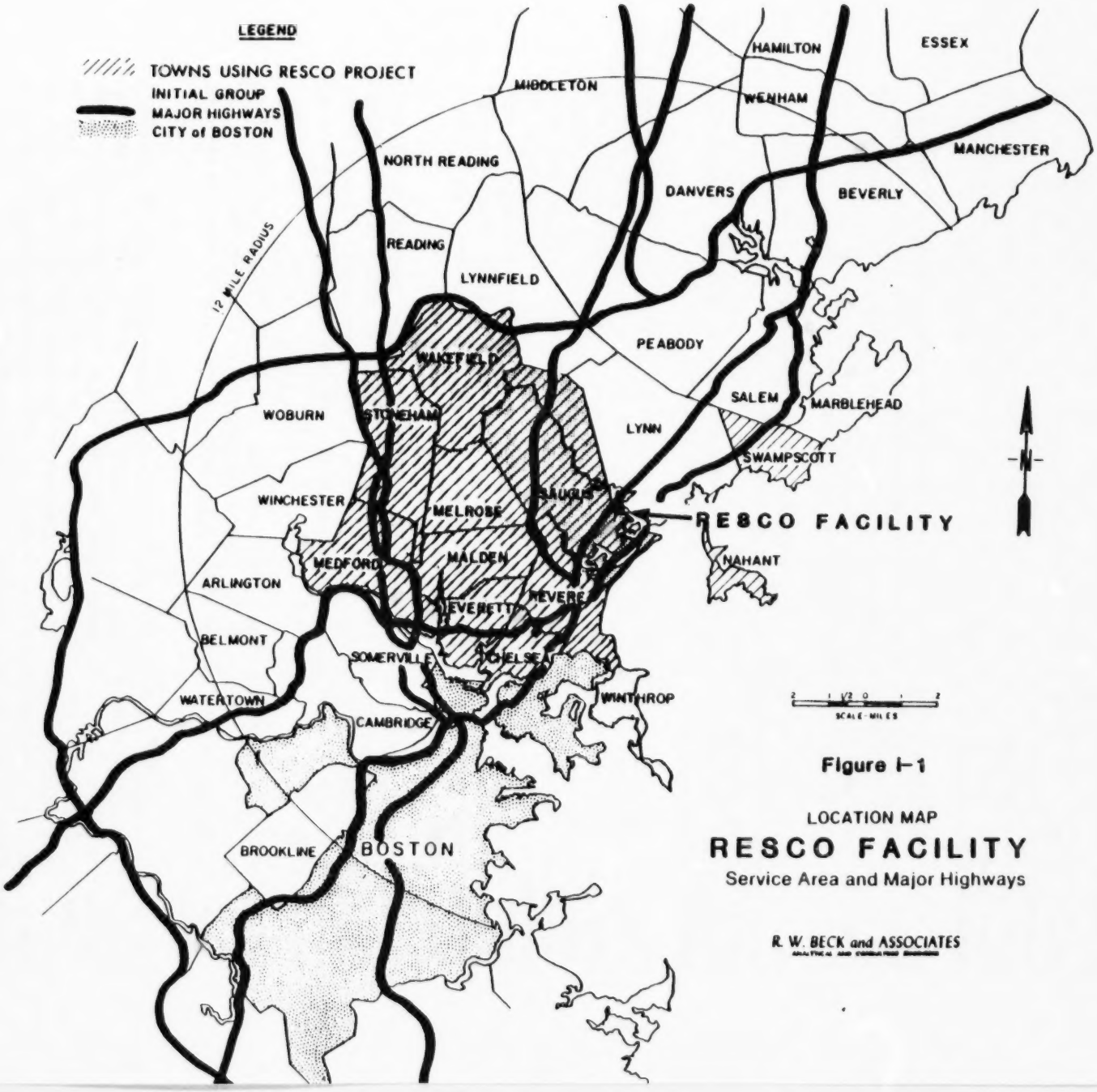


Figure I-1

LOCATION MAP

RESCO FACILITY

Service Area and Major Highways

R. W. BECK and ASSOCIATES

Table i-1

FACT SUMMARY
RESCO RESOURCE RECOVERY FACILITY
SAUGUS, MASSACHUSETTS

Population served:	750,000
Operations began:	November, 1975
Principals:	RESCO (a joint venture of Wheelabrator Systems, Inc., and the M. DeMatteo Construction Co.) - designed, arranged financing, managed construction, and now operates the plant. General Electric Co. - steam purchaser under a 14-year contract with RESCO; strong supporter of project development. 13 municipalities, two districts of Boston, and towns in Maine and New Hampshire - supply solid waste to the plant under long-term contracts or, in Boston's case, under short-term agreements. Massachusetts Bureau of Solid Waste Disposal - permit co-ordinator. MITRE Corporation - evaluated and mediated solid waste supply agreements.
Volume:	1,150 TPD, 7 days per week, 24 hours per day (currently). Average operating capacity is 1,200 TPD. Maximum capacity is 1,500 TPD.
Technology:	Mass Burning in von Roll waterwall incinerators, with Wheelabrator-Lurgi electrostatic precipitators for air emissions control, and with magnetic separation of ferrous metal from combustion residue.
Product:	Steam (625 psig; 785-825°F), up to 370,000 lb/hr, with typical production 300,000 lb/hr. Recovered ferrous metal - 60 to 80 TPD.
Residue:	Approximately 20% (by weight) of incoming refuse. Residues are stored near the facility.
Costs:	Total capitalization $51 million • $10 million original equity, half from each RESCO partner • $30 million Town of Saugus industrial revenue bonds • $11 million additional equity, half from each RESCO partner Leverage lease arrangement between RESCO and Saugus. Plant construction costs were $38 million. The rest of the capital raised has gone to equipment improvements, bond reserve funding, and other working capital and start-up costs.
Revenues:	• Tipping fees, average approximately $16 per ton. • Steam sales: GE pays its avoided cost less 10%. • Ferrous metal sales. • Interest on funds held in trust.
Procurement:	Sole source approach

CHAPTER 1 - PROJECT ORIGIN

IDENTIFICATION OF NEED

Energy Need

The energy needs of the General Electric Company's Riverworks Division turbine plant in Lynn sparked the initial interest in a refuse-to-energy project for the Saugus area. In 1965, GE saw that it would need to replace two of its large industrial boilers by 1970 and 1971. It also recognized a solid waste disposal problem in the area, and contracted with consulting engineers for an initial study of the conversion of waste to energy. The 1967 study, funded by an HEW grant, concluded that to supply energy to GE in the desired quantity, more waste would be needed than was present in the Town of Lynn.

Waste Disposal Need

In July, 1967, waste disposal problems in the Saugus area were highlighted when area citizens picketed the regional landfill operated by M. De Matteo Construction Company. The landfill, located on marshland near Massachusetts Bay, was subject to periodic tidal inundations which had a noticeable and serious effect on the quality of nearby water. The landfill's unsightly appearance was also a cause of citizen concern. In September of that year, the Saugus Board of Health revoked the landfill license and ordered the landfill closed within 30 days. Since alternative disposal sites were not available, the state governor declared a health emergency and ordered the site reopened. By court order, the Town of Saugus was prevented from further interference with landfill operations. This order was appealed in 1971 by the new Saugus town manager, who, coincidentally, was a GE employee on a leave of absence. The court granted the appeal but gave the municipalities using the site three years to find an alternative to the landfill.

At this point, De Matteo proposed to GE that De Matteo build and operate a refuse-to-energy plant for GE. De Matteo then was encouraged by GE to work with Combustion Engineering (CE). In 1971, De Matteo and CE formed THESCO - Thermal Energy Systems Company - and THESCO and GE began to negotiate a steam contract. Eight months later, unable to reach a joint agreement with DeMatteo, CE announced its withdrawal from the project.

This was a critical juncture in the planning process. The initial needs still existed: GE was scheduling replacement of two more boilers in 1974 and 1975, and the landfill could only be used for another two to three years. When CE withdrew from THESCO, GE gave DeMatteo two weeks to find another partner. At GE's suggestion, De Matteo sought to team up with Wheelabrator-Frye, Inc., which had recently acquired a strong power plant engineering capability in Rust Engineering. As holder of the American license for Von Roll waste-to-energy technology, Rust was in an ideal position to help. An agreement was quickly reached among these parties. On April 3, 1973, Refuse Energy Systems Company (RESCO) was formed as a joint venture of Wheelabrator and De Matteo, and GE signed a steam contract, essentially the same as the THESCO contract, with RESCO.

KEY PARTICIPANTS

General Electric Company, Riverworks Division

This plant's chief business is the manufacture of turbines for aircraft, power production, and other applications. The plant uses steam to generate electricity, for process and environmental heat, and in turbine testing. High demand during testing necessitates the

maintenance of eight large industrial boilers at the facility; the RESCO plant has taken the place of two of these boilers, which have been retired.

In addition to the initial involvement described above, GE provided a small portion of the land in Saugus now occupied by the RESCO site. GE also worked to obtain amendments to state legislation permitting solid waste facilities to be financed with industrial revenue bonds.

M. De Matteo Construction Company

The De Matteo Company's involvement began in 1961 when it purchased the Saugus landfill site and began to accept refuse there. As a result of events described above, De Matteo entered a joint venture with Wheelabrator Energy Systems, Inc. (WESI) to form RESCO. DeMatteo supported passage of legislation permitting the issuance of industrial revenue bonds for the facility. The company put up half of the $10 million in initial equity and part of the $11 million subsequent investment to shakedown construction and early operation of RESCO. The company continues to be actively involved in day-to-day operations at the plant, hauling ash to the adjacent storage site on the former DeMatteo landfill.

Wheelabrator-Frye, Inc.

Through its wholly-owned subsidiary Wheelabrator Energy Systems, Inc., the company joined De Matteo in forming RESCO. With other subsidiaries, notably Rust Engineering and Wheelabrator Financial Corporation, they provided design, construction management, financing, and support for shakedown research and development.

Nine Municipalities

When the DeMatteo landfill was closed briefly in 1967, Saugus, Malden, Chelsea, Everett, Medford, Melrose, Revere, Stoneham and Wakefield were the users of the landfill that met as a group (the North Shore Waste Disposal District) to attempt a regional solution to their disposal problem. Malden provided initial leadership to the NSWDD by virtue of their mayor's prior experience with a similar project. The NSWDD attempted to organize a regional project with encouragement and support from General Electric. Disagreements among the towns in the NSWDD concerning facility siting, taxation, road use, and other issues could not be resolved. The technical feasibility of the project was not at issue. Eventually, General Electric set a deadline for NSWDD to propose a specific project; when that deadline could not be met, GE and De Matteo began project planning independent of the NSWDD. Subsequently, the Town of Saugus has played a principal role in all negotiations concerning RESCO and in handling complaints stemming from plant operations.

These nine towns signed 20-year waste disposal contracts with RESCO in 1975. The contracts include a provision that RESCO may not offer a lower tipping fee to any other waste supplier.

White, Weld and Co.

This firm served as underwriter of the bond issue. White, Weld hired an outside engineering firm, R.W. Beck and Associates, to do an independent feasibility study of the project. This study was included in the bond prospectus.

MITRE Corporation

This nonprofit consulting group examined RESCO financial plans and waste collection and disposal in the nine communities to 1) assess the fairness of the RESCO tipping fee and 2) provide RESCO with information on the quantity and composition of waste from these communities. The nine municipalities accepted MITRE's conclusions and chose to accept the RESCO tipping fee. This provided the basis for the waste supply contracts that assured the viability of the project.

CHRONOLOGY

The chronology of events leading up to full operation of the Saugus facility was somewhat unconventional. Table 1-1 is a list of major events in the RESCO project to date.

A unique feature of the Saugus chronology is the beginning of construction well before the issuance of any bonds, the securing of the waste supply, or final approval of the Environmental Impact Report. During initial stages of construction, most of the costs were financed by RESCO. RESCO and its backers took this risk on the assumption that the waste had nowhere else to go. Later, the presence of the nearly-completed plant lent an advantage to RESCO in bargaining with supplying communities.

FEDERAL, STATE AND LOCAL REGULATIONS AND PERMITS

The RESCO plant was designed and constructed only a few years after a wave of environmental legislation created many new regulatory bodies and caused others to be reorganized. For those interested in speedy project completion, the timing could hardly have been worse. Agencies had little experience applying their own regulations and lacked coordination with other agencies.

A total of thirty permits from federal, state and local agencies were required for this project. This number of permits was considered unusually large at the time. The operation of a solid waste facility, air emissions from a refuse incinerator, the bridging of inland waterways, construction on an estuary, and the modification of roads all had some permitting requirements. Siting on a former landfill, and in a wetlands area, contributed to the large number of permits required. The interlocking nature of some permits caused short delays in the project until one state agency (the Massachusetts Bureau of Solid Waste Disposal in the state Department of Environmental Management) assumed responsibility for permit coordination and assigned one employee to that task on nearly a full-time basis. The permitting agencies and number of permits required are listed in Table 1-2.

Table 1-1

SAUGUS CHRONOLOGY

DATE	EVENT
1965	GE realizes need for boiler replacement
1967	GE/Lynn feasibility study (HEW grant)
1967	De Matteo landfill picketed
1968	North Shore Waste Disposal District formed
1971	THESCO formed by De Matteo & Combustion Engineering
1971	Court orders landfill closed in three years
April, 1973	RESCO formed by De Matteo & Wheelabrator-Frye
April, 1973	RESCO & GE sign contract
1973	Waste supply negotiations begin
July, 1973	Engineering begins, site prep begins
1974	Initial ash satudy at Notre Dame (sponsor: Wheelabrator-Frye)
May, 1974	Facility construction 20% complete
Feb, 1975	Saugus issues industrial development bonds, $15.5 million
April, 1975	Facility 70% complete
April, 1975	Draft EIR reviewed, questions raised concerning noise and ash disposal
May, 1975	First waste supply contracts signed
June, 1975	Boilers fired with oil
July, 1975	Final EIR approved
August, 1975	Saugus issues $30 million in industrial development bonds (refunds prior issue)
October, 1975	Approval of design granted by DEQE
October, 1975	Approval of interim storage of ash at RESCO
November, 1975	Noise disturbance results in citizen complaints
November, 1975	RESCO begins steam service to GE
December, 1975	Last initial waste supply contract signed
1976	Ash leaching impact study begun
October, 1977	Additional investments by RESCO now total $7.5 million for capital improvements
August, 1978	DEQE order re black flake problem
October, 1978	Modifications begin to rectify air pollution problems
November, 1979	RESCO tests show compliance with air emission regulations
August, 1980	"Ash as landfill cover" study begun
August, 1980	"Ash as pavement" study begun

Table 1-2

PERMITS REQUIRED

Issuing Authority	License, Permit or Other Approval
Massachusetts Department of Natural Resources	Site permit (2)
	Final approval for utility bridge.
	Final approval for temporary barge mooring facility.
	Approval of final plan details of site changes.
Massachusetts Water Resources Commission	Water quality certification regarding utility bridge.
	Water quality certification regarding temporary barge landing area.
Massachusetts Department of Public Health, Bureau of Water Supply and Water Quality	Approval of connection to public water supply.
Federal Aviation Administration	Approval of stack height.
Department of the Army, Corps of Engineers	Determination that proposed utility bridge is not under jurisdication of Corps of Engineers but under jurisdiction of United States Coast Guard.
	Determination that temporary barge mooring facility is not under jurisidiction of Corps of Engineers.
United States Coast Guard	Bridge permit for the construction of the utility bridge.
Town of Saugus, Board of Selectmen	Permit for the facility and permit approving height of the facility.
Town of Saugus, Board of Health	Assignment of the site for the facility.
	Approval to discharge into the Town's sewer system.
Town of Saugus, Public Works Department	Approval to install and connect sanitary sewer line.

Town of Saugus, Building Inspection Department	Building permit.
Town of Saugus, Head of Fire Department	Licenses for storage of fuel oil.
Town of Saugus, Harbormaster	Permit for a temporary barge mooring facility.
Town of Saugus, Board of Selectmen	Approval under Zoning By-Law for enaction of an accessory sign.
Massachusetts Legislature and Governor	Chapter 825 of the Acts of 1973 authorizing the construction of the utility bridge subject to the obtaining of other necessary approvals.
Massachusetts Department of Public Works and Governor	License for the construction of the utility bridge.
Massachusetts Department of Public Works	Permit for temporary highway opening for trench construction and sewer installation.
Massachusetts Department of Public Works, Right of Way Bureau	Abandonment and released old drainage easement.
Massachusetts Executive Office of Environmental Affairs	Approval of the final Environmental Impact Report for the Facility.
Massachusetts Department of Public Works	Permit for a curb cut and highway access opening.
Massachusetts Department of Environmental Quality Engineering	Department of Environmental Quality Engineering approval of the proposed use, plans and proposed operating procedures for the facility. This includes: • air pollution control • odor control • operating procedures • stack construction and particulate dispersal model • ash residue disposal.

CHAPTER 2 - PROJECT DESCRIPTION

LOCATION

Plant Location

The RESCO plant is located in the southeastern portion of Saugus (see Figure i-1), bordering the Saugus River and adjacent marshland. The site also borders the former landfill for Saugus and nearby communities; this landfill was the source of controversy while still in operation (see Chapter 1, Identification of Need). Across the Saugus River from RESCO in the Town of Lynn is the General Electric Riverworks turbine manufacturing plant, RESCO's sole steam customer. The surrounding area is primarily light industrial and urban in character. Only a small part of the estuary and marshland bordering Massachusetts Bay remains in a natural state.

Wasteshed

The locations of the communities supplying waste to RESCO were shown in Figure i-1; a full listing appears in Table 2-1. Refuse is collected and brought to the facility by municipalities and by private haulers under contract to municipalities. In addition to municipal refuse, a significant portion (roughly 20%) of the plant input is brought by commercial haulers serving businesses, light industry, and other generators of refuse in the Saugus area.

TYPE OF SYSTEM

The RESCO plant falls into the "mass burning, waterwall" category of refuse processing facilities.

Arriving vehicles deposit unprocessed refuse in a receiving pit. Overhead cranes pick up the waste and fill the charging throats of the two furnaces when necessary. Material passes down a throat and into the furnace. Reciprocating grates carry the refuse through the furnace, where it ignites and burns. No auxiliary fuel is required. Within the furnace, water-filled tubes receive heat from the burning refuse; the water boils and the resulting steam is heated further in the superheater. Air pollution is controlled with 2-field electrostatic precipitators. Ash is quenched, then carried through a metals removal system; the metal is sold as scrap and the remaining residue is stockpiled at the site. Figure 2-1 illustrates the RESCO system.

PLANT DESIGN RATES/SPECIFICATIONS

Processing Capacity

The plant was initially designed to process 1,500 TPD, seven days per week, of waste through two furnaces. Room for two additional furnaces was provided in the design, and the receiving pit was sized accordingly.

The average processing rate, for financing and design purposes, was assumed to be 1,200 TPD, seven days per week.

Feed Material Specifications

A composition study of refuse to be delivered to RESCO was not performed prior to construction of the facility. Tests of refuse conducted in the Boston area, combined with estimates from studies performed for Federal and state agencies, led the designers to conclude that the heat value of input refuse would generally exceed 4,500 BTU/lb.

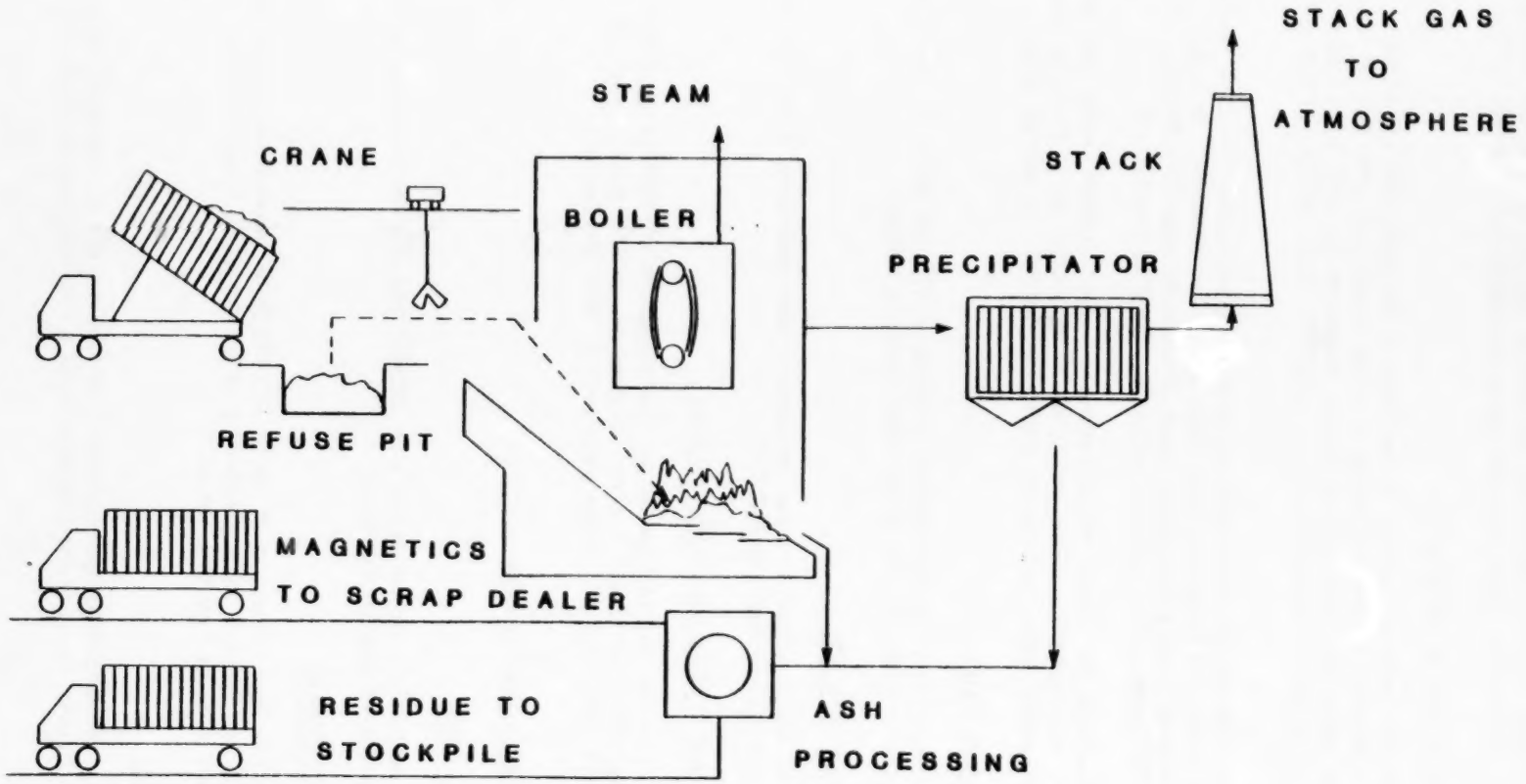
Table 2-1

RESCO WASTESHED COMMUNITIES

Community	Contract Expires
Chelsea	1995
Everett	"
Malden	"
Medford	"
Melrose	"
Nahant	unavailable
Revere	1995
Saugus	"
Stoneham	"
Lynn	1999
Swampscott	1985
Wakefield	1995
Winthrop	"
Somerville	"
Boston	short-term

Figure 2-1

RESCO SYSTEM DIAGRAM



No hazardous wastes, explosives, demolition wastes, radioactive waste, chemical wastes or other potentially harmful or damaging materials are accepted by the facility.

Product Output Specifications

The primary product, steam, is received by General Electric at rates of up to 370,000 lb/hr. Demand varies according to GE's production and testing schedule. RESCO's contract with GE requires it to supply steam on demand, with 8 hours' notice. GE has specified steam conditions as 625 psig, 825°F. Low-pressure steam is returned from GE to RESCO.

To meet the energy customer's reliability requirements, the main boilers were provided with auxiliary oil burners. These have since been removed. In addition, two smaller oil-fired back-up boilers (combined steam production capacity: 240,000 lb/hr) are located on the RESCO site. The auxiliary fuel is #6 2%-sulfur residual oil.

Specifications for scrap metal recovered from residue were not made available by RESCO management. This material is recovered by a trommel and a rotary drum electromagnet, then conveyed to trucks for storage and sale as scrap.

Production Rates

Steam production was designed to range up to 370,000 lb/hr. Scrap metal production was estimated originally at 7% of the input material weight.

Residue Production

Prior to construction, residue production was estimated conservatively as 40% of the input material tonnage, or 480 TPD.

Equipment Performance Specifications

Steam, ferrous, and residue output specifications are mentioned above. The dry-bottom electrostatic precipitators were designed to control particulates to 0.050 gr/scf, corrected to 12% CO_2; this is the equivalent of 99% efficiency.

ACTUAL PLANT RATES

Refuse Input

As of early 1981, refuse delivery to RESCO was slightly in excess of 1,150 tons per day, averaged over a seven day week.

Product Outputs

Steam has been produced at up to 370,000 lb/hr; production commonly ranges between 160,000 and 300,000 lb/hr, according to GE demand. Scrap metal is recovered from ash at about three or four tons per hour.

Residue

Residue production is approximately 20% by weight of incoming refuse; this is half the design figure. Tests of this material show a combustibles content of 3% to 4%.

PHYSICAL PLANT AND STAFF

Figure 2-2 shows a site plan for the facility. The area of the entire site is 13 acres. The processing plant occupies 2.2 acres. The weigh scale and truck turnaround occupy additional area.

Materials Flow

Incoming waste is weighed using a truck scale (badge-reader type), then discharged into the 200 ft x 39 ft x 86 ft deep pit (capacity: 6,700 tons) at the front of the facility. One of two travelling overhead cranes picks up refuse and places it into the throat of a furnace. Waste moves within each of the two furnaces over a series of three reciprocating grates. The grates are stepped so that waste tumbles when passing from one grate to the next; this promotes complete combustion. Furnace exhaust gases pass through the superheater, boiler, and economizer, to the electrostatic precipitator. To prolong boiler tube life, mechanical rappers are used to dislodge soot; after rapping, the thin layer of soot that remains protects the tube from corrosion. Bottom ash is collected below the grates, and together with fly ash is conveyed through a quench tank. Quenched residue passes through one of two trommel screens with 2-1/2 inch round holes. Oversize material is conveyed to a scrap metal truck. Undersize material is scavenged with a rotary drum magnet. The recovered magnetics and the oversize material are stored and sold separately. The residue is conveyed to an ash truck for storage at the site. Ash removal equipment is fully redundant.

Studies are underway exploring use of the residue as a road subbase, an asphalt admixture, and an additive to masonry products.

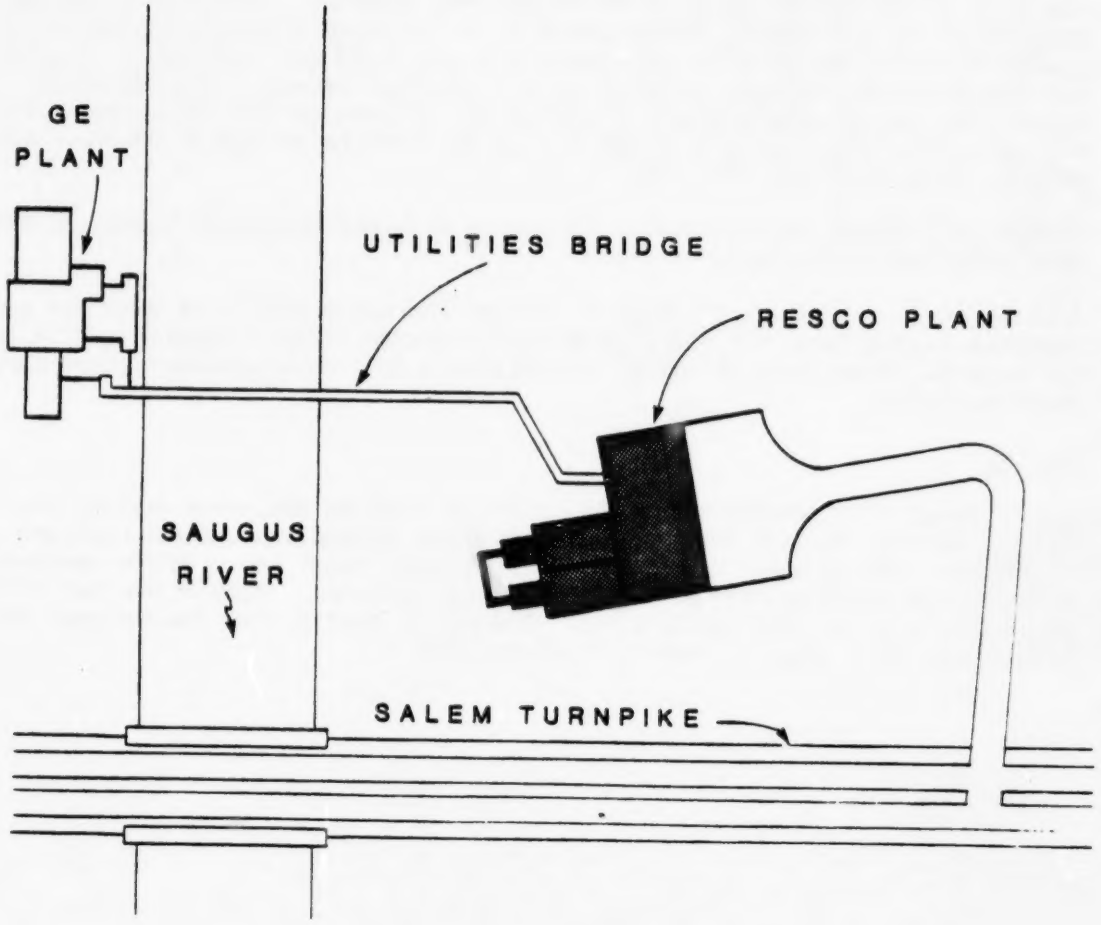
A small amount of low-pressure steam is returned from GE to RESCO for deaerator and feedwater heating uses. GE also cogenerates electricity, which it supplies to RESCO. For returning these forms of energy, GE receives a BTU credit against high-pressure steam purchases.

Staffing

Approximately 55 employees operate the facility 24 hours per day, seven days per week. This includes four shifts of seven operating personnel, several management staff, and a maintenance crew of eight to ten workers. At present, about twenty of the operating personnel have received state power plant operator's licensing. Many of the staff have been with the plant since construction. Training of staff is done "on-the-job," and through cooperative programs with other power plants.

Figure 2-2

RESCO SITE PLAN



CHAPTER 3 - PROJECT FINANCES AND RISK ALLOCATION

METHOD OF FINANCE

The method of finance for the RESCO plant is a "leverage lease" arrangement. The Town of Saugus was able to establish the Saugus Industrial Development Financing Authority and to issue Solid Waste Disposal Revenue Bonds. The first such issue was for $15.5 million, early in the construction period; this was supplanted by a $30 million dollar issue six months later. These bonds are tax-exempt. Saugus holds the title to the facility and has leased it to RESCO for a 20-year period. RESCO's initial contribution of equity was $10 million, or 25% of total capital cost. For tax purposes, RESCO is considered the facility owner; RESCO receives the investment tax credit and a depreciation allowance, and must pay taxes on the facility. Under Massachusetts law, the Authority established by Saugus allows the Town to issue tax-exempt industrial development bonds without affecting its indebtedness limit.

Under terms of the lease, RESCO's obligations include:

- lease payments, which are comprised of all bond payments, outlays to maintain the Bond Reserve fund, and payments for trustee fees
- acting as the Town's agent for acquisition, construction, and installation of the plant
- covering construction expenses beyond the $30 million
- maintaining and operating the facility

RESCO also has the option to terminate the lease by paying off the bonds and other facility debts.

When the lease term expires (December 1, 1994, under ordinary circumstances) and payment of the bond is provided for, Saugus must sell the facility to RESCO for $1, and RESCO must purchase it.

Under the terms of the bond issue, the bonds are tax-exempt revenue bonds (not general obligations of Saugus) paid by the lease payments from RESCO and further secured by a mortgage on the facility. Early work by General Electric found that general obligation bonds would be too cumbersome to administer for this regional project, and would use too much of Saugus' bonding capacity.

At the time of the bond issue, RESCO had contributed $10 million in capital for a total of $40 million in capital raised. A cost estimate of May 24, 1975 gave a capital cost of $38.3 million; components of the estimate are shown in Table 3-1. Between May, 1975 and August, 1977, the RESCO owners contributed an additional $11 million for equipment improvements ($7.5 million), bond reserve funding ($3.3 million) and other working capital and startup costs ($200,000). Total capitalization rose to $51 million. In that interval, RESCO had not yet made a profit.

The New England Merchant's National Bank was designated trustee for the bonds, and must maintain three trust funds: 1) Construction Fund 2) Bond Fund 3) Bond Reserve Fund. Lease payments are made to the trustee, who places monies in these funds as directed by the indenture document. The funds are invested in short-term obligations by the trustee, and are used to defray various project costs.

Table 3-1

RESCO FACILITY ESTIMATED COST
(prepared May, 1975)

	Total Cost
Land	$ 772,000
Site Development	1,643,000
Refuse Receiving and Handling	4,388,000
Refuse Combustion Building, Chutes, Grates, Furnaces, Boilers, etc.	16,434,000
Stand-by Boilers	771,000
Pollution Abatement Equipment	2,674,000
Ash Handling and Disposal	2,394,000
Boiler Feedwater Supply and Treatment	712,000
Utility Bridge	2,030,000
Utilities and Miscellaneous	1,156,000
Total Project Construction Cost	$32,974,000
Interest During Construction	2,099,000
Real Estate Taxes	313,000
License and Contracting Fees	1,455,000
Cost of Financing	1,200,000
Start-up Costs - Net	227,000
	$38,268,000

FINANCIAL PERFORMANCE

This discussion is developed from the point of view of RESCO, the facility operator and eventual owner.

Revenues

Tipping fees are one major source of revenue. The fifteen communities listed in Table 2-1 pay an average tipping fee of nearly $16 per ton. Most have signed 20-year waste supply agreements with RESCO; one has opted for a 10-year agreement at higher cost. The City of Boston delivers refuse under a short-term agreement. Municipal tipping fees are adjusted each year; 50% of the annual percentage change in the local Wage Survey Index (U.S. Department of Labor) and 20% of the annual percentage change in the base property tax rate of Saugus (and/or increase in the facility's assessed value) are applied to the base tipping fee ($13 per ton for most towns). As of October 1980, the Saugus tipping fee was $15.47 per ton. In addition to municipally-collected waste, about 20% of the plant input is brought by commercial haulers serving businesses and light industry in the Saugus area. These haulers are under short-term agreements with RESCO.

Sale of steam is another principal source of revenue. Steam price is calculated based on the avoided cost for GE to produce steam, less ten percent. The ten percent discount provides incentive for GE to remain with the project. This price includes factors such as maintenance, depreciation, labor, and fuel oil costs. Variations in the price of steam will be linked closely to the price of fuel oil. Exact terms of the contract are proprietary. The contract ends in 1990, but RESCO expects it to be extended.

Steam revenues in fact represent the net value of the exchange of several forms of energy between General Electric and RESCO: high-pressure steam, return low-pressure steam, electric power, and fuel oil. RESCO supplies the first of these to GE, and GE supplies the other three to RESCO, using pipeline or cable crossing the Saugus River.

In cash flow projections, sales of ferrous scrap are a minor source of revenue (2% to 3% of total revenues), as is revenue from interest on funds held in trust.

Revenue from the DOE oil entitlements program was on the order of $3.50 per ton of refuse processed. The entitlements program ended in January, 1981.

Expenses

Debt service on the facility is an important expense, averaging about $3 million per year, or about $7.00 per ton (assuming 1,200 TPD, seven days per week).

Operation and maintenance is a second major expense for the facility. Actual operating costs are currently (May 1981) $10.50 to $11.50 per ton of refuse processed. These figures do not include residue disposal, water, electricity, or property taxes.

Property tax, paid by RESCO to Saugus, is the third largest expense for the plant. It was initially set at $1 million per year, or about $2.25 per ton, and was raised in 1977 to $1.4 million annually. The property tax levied on RESCO is an unusual situation. Prior to construction, RESCO agreed not to declare the plant a manufacturing facility; Saugus could, therefore, assess it as a real property, doubling the local tax revenue on the plant. By assuming ownership for tax purposes, RESCO gained the advantage of accelerated depreciation and the investment tax credit. Subsequent to the construction of the RESCO plant, a law was enacted in Massachusetts limiting the local tax on a resource recovery plant to $1 per ton processed; this law does not apply to RESCO.

A flow diagram (Figure 3-1) illustrates the transactions outlined above. The cash flow projections given in the original $30 million Town of Saugus bond issue prospectus are presented in Table 3-2.

Since the cash flow projection was made, several major changes have occurred. These were summarized by White, Weld & Company in 1977; some highlights are as follows:

- Steam price rose faster than expected.
- Scrap metals revenue was far below the forecast amount.
- O&M costs were about 25% over expectations; this average was expected to diminish in future years.
- Property taxes were increased 35% to $1.4 million per year; RESCO contested this increase and lost.
- The supplemental fuel expense became negligible.

In addition, revenues from disposal fees were initially lower than expected. During start-up, RESCO was unable to use the DeMatteo landfill for backup disposal; thus the project could initially contract only for the capacity of one boiler. This impacted project revenues for the first two years of operation.

When combined with the need for shakedown modifications at the plant, the overall effect of these changes was to require additional capital from the project proponents. Since the beginning of plant operations, over $10 million has been invested by RESCO toward capital improvements and start-up costs.

At this time (spring 1981), the RESCO project is reportedly earning a profit.

RISK ALLOCATION

The allocation of risks in this project is addressed most comprehensively in the prospectus for the Saugus $30 million bond issue and in the feasibility study by R. W. Beck and Associates included with the prospectus.

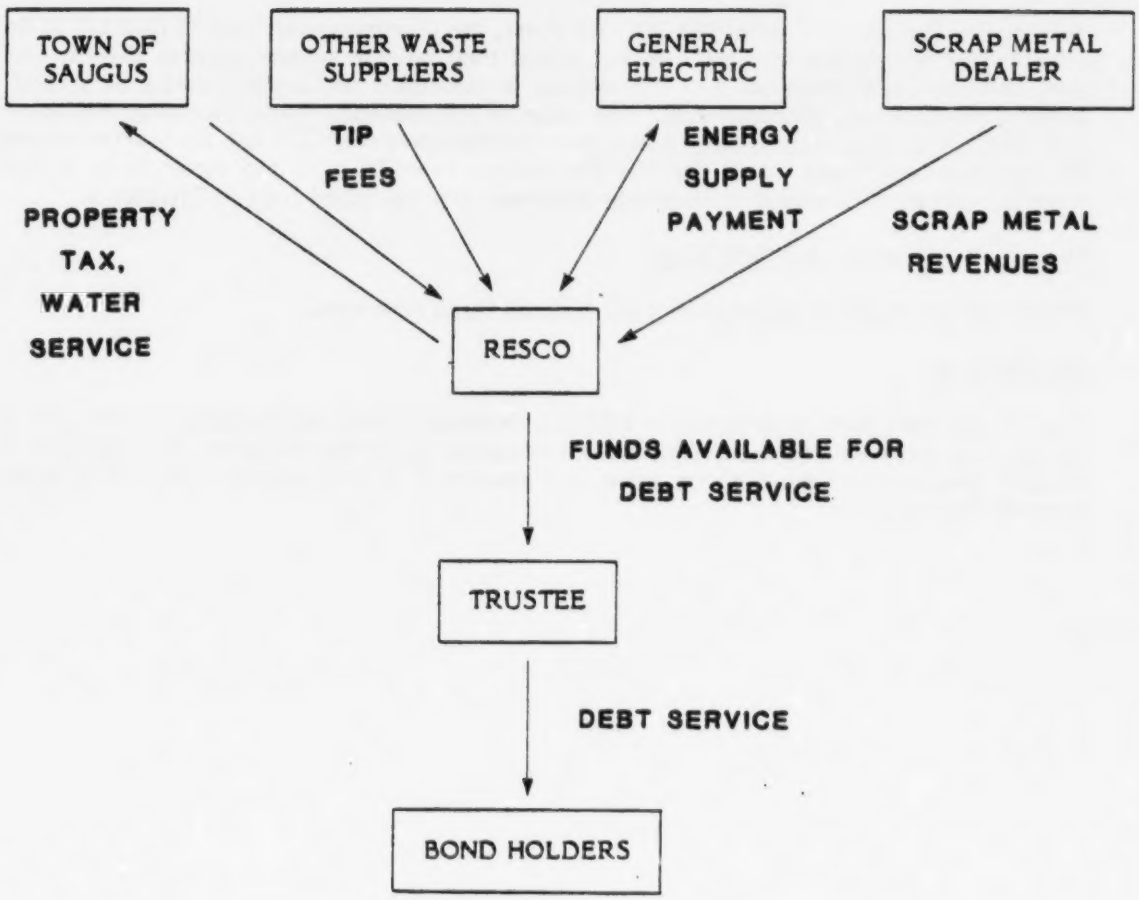
Waste Supply

The risk of obtaining a continued waste supply is entirely RESCO's. Long-term contracts for refuse are not sufficient to operate the facility at a consistent profit. The plant must offer a competitively-priced disposal alternative to the short-term contractors (mainly commercial haulers) in order to remain profitable. RESCO is obligated to accept waste from all of its contracted haulers, and must find an alternative disposal site if unable to burn the material. This has never been necessary, and no contractual arrangements have been made for a backup landfill. The DeMatteo landfill is not a possible backup disposal site.

Under their long-term contracts with RESCO, the towns supplying waste may increase or decrease their delivery by 10% per year without penalty. This would enable a community to institute a phased recycling or resource recovery program of its own and still fulfill the terms of its contract. The provision helps protect RESCO from unexpected drops in its waste supply.

Figure 3-1

FINANCIAL TRANSACTIONS DIAGRAM



Energy Market

The General Electric steam purchase contract expires in 1990, well before the end of the project life. RESCO must take steps to renew this contract. Under the existing agreement, the risk of GE abandoning RESCO prematurely is mitigated by a "buy-out" clause, which would require GE to pay a substantial penalty for ceasing to purchase steam. GE has contracted to purchase a yearly minimum of two billion pounds of steam at rates of between 65,000 and 350,000 lb/hr, or pay a penalty. RESCO must supply steam to GE on demand, with eight hours notice, although there is a limit to the number of hours per year that GE can demand the maximum rate. RESCO must pay a penalty if it cannot supply GE's demand. Payments of this type were necessary during the startup period, when modifications to boiler tubes and combustion chamber geometry were being made. Exact details of the RESCO-GE contract are proprietary information.

Disposal of Residuals

Here again, the risk lies with RESCO. At worst, the Commonwealth could find ash to be a hazardous waste; the cost of disposal would then have a severe adverse effect. At best, testing could establish that the residue is innocuous and in fact useful as a road-building sub-base or other material. The value of the material would then augment other revenues. As it now stands, Saugus has given permission to RESCO and De Matteo to use the material as a base cover for the De Matteo landfill, with top cover to be a soil material. Other ash residue studies now underway are described fully in Chapter 4.

Facility Construction and Operation

RESCO assumed prime responsibility for both of these functions.

Debt Service

The risk for debt service is borne by RESCO. Revenues from the facility are pledged to service the debt, and the facility has been mortgaged as further security. In the event of default, Saugus may take over the plant and operate it or find another operator in order to cover debt service.

Table 3-2

REFUSE ENERGY SYSTEMS COMPANY

Projection of Operating Results
1976-1994
(All Figures in Thousands)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Tons of Refuse Processed (1)	365	438	438	438	438	438	438	438	438	438	438	438	438	438	438	438	438	438	438
REVENUES																			
Disposal Service .....(2)	$ 4,745	$ 5,865	$ 6,003	$ 6,191	$ 6,376	$ 6,573	$ 6,789	$ 7,033	$ 7,287	$ 7,574	$ 7,873	$ 8,164	$ 8,472	$ 8,798	$ 9,142	$ 9,504	$ 9,889	$10,394	$10,839
Sales of Steam .....(3)	4,581	4,549	4,541	4,511	4,504	4,498	4,491	4,484	4,480	4,476	4,473	4,473	4,473	4,473	4,473	4,473	4,473	4,473	4,473
Sales of Ferrous Scrap ..(4)	256	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307
Interest Income .....(5)	226	350	383	399	405	410	408	390	373	336	301	286	272	257	243	229	214	103	74
Total Income	9,808	11,071	11,234	11,408	11,592	11,788	11,995	12,214	12,447	12,693	12,954	13,230	13,524	13,835	14,165	14,513	14,883	15,277	15,693
EXPENSES																			
Operation and Maintenance .....(6)	2,240	2,374	2,516	2,667	2,827	2,997	3,177	3,368	3,570	3,784	4,011	4,251	4,507	4,777	5,064	5,367	5,689	6,031	6,393
Supplemental Fuel ....(7)	285	285	285	285	285	285	285	285	285	285	285	285	285	285	285	285	285	285	285
Administrative and General .....(8)	336	356	377	400	424	450	477	505	536	568	602	638	676	717	760	805	853	905	959
Property Taxes .....(9)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Subtotal	$ 3,861	$ 4,015	$ 4,178	$ 4,352	$ 4,536	$ 4,732	$ 4,939	$ 5,158	$ 5,391	$ 5,637	$ 5,898	$ 6,174	$ 6,468	$ 6,779	$ 7,109	$ 7,457	$ 7,827	$ 8,221	$ 8,637
Funds Available for Debt Service (A)	$ 5,947	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056	$ 7,056
DEBT SERVICE																			
Interest Payment ....(10)	$ 2,250	$ 2,250	$ 2,213	$ 2,156	$ 2,063	$ 1,950	$ 1,819	$ 1,680	$ 1,533	$ 1,365	$ 1,208	$ 1,050	$ 919	$ 788	$ 656	$ 525	$ 394	$ 263	$ 131
Principal Payment	0	500	750	1,250	1,500	1,750	1,850	2,100	2,100	2,100	2,100	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750
Total Debt Service Requirement (B)	$ 2,250	$ 2,750	$ 2,963	$ 3,406	$ 3,563	$ 3,700	$ 3,669	$ 3,780	$ 3,633	$ 3,465	$ 3,308	$ 2,800	$ 2,669	$ 2,538	$ 2,406	$ 2,275	$ 2,144	$ 2,013	$ 1,881
Debt Service Coverage (A) ÷ (B)	2.64	2.57	2.38	2.07	1.98	1.91	1.92	1.87	1.94	2.04	2.13	2.52	2.64	2.78	2.93	3.10	3.29	3.51	3.75

FOOTNOTES:

1) During the initial year of operation, the Facility is estimated to operate at an annual daily average of 1000 tons of refuse per day. Thereafter, the Facility is estimated to operate at an annual daily average of 1200 tons of refuse per day.

2) Revenues from the disposal of refuse are projected at $13.00 per ton in 1976. They are projected to increase thereafter at a rate of approximately 3½% per year, representing: (a) on that portion of the refuse processed under the long-term contracts, in accordance with the terms of such contracts, an increase of 3% per year, i.e., ½ the assumed rate of inflation of expenses and (b) approximately 4% per year on the balance of the refuse.

3) The sale of steam is based upon an assumed fuel cost of $12.00 per barrel and the specifications of the GE Contract. Increases or decreases in the price of oil within a range which we believe is probable within the forseeable future would not materially affect the economics of the Facility's operation at the 1,200 tons-per-day level due to the fact that the cost of steam to the GE Plant is adjusted for the price of oil. It is also assumed that it will be economically advantageous for General Electric to renew the contract beyond the existing 14½ year period so that RESCO will continue to sell steam to General Electric throughout the term of the Bonds.

4) The recoverable portion of the ferrous metal content of refuse is estimated to be 7% of the original weight of the refuse. The sale of this ferrous metal is projected to net $10.00 per ton. No other recoveries are projected.

5) The Interest Income on the Bond Reserve Fund is assumed to be 5.5%.

6) The Operation and Maintenance expense is escalated at the assumed inflation rate of 6% per year.

7) The cost of Supplemental Fuel is based upon a fuel cost of $12.00 per barrel and the steam requirements which we believe the company will have to supply to General Electric.

8) Administrative and General Expense is assumed to be 15% of Operation and Maintenance Expense. The estimate is based upon studies performed by the Federal Power Commission for the Administrative and General Expenses associated with steam generating plants.

9) Property taxes are assumed to remain constant at $1,000,000 per year.

10) Debt Service Interest is assumed to be 7.5%.

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CHAPTER 4 - PROJECT EVALUATION

PLANT RELIABILITY

The RESCO plant stands out as a reliable resource recovery plant. Since the start of operations in November 1975, not one contracted refuse truck has been turned away. Over the first two years of operation, downtime for each unit averaged 23% per year, with 75% of this scheduled, 25% unscheduled. In the most recent two years, downtime has been about 20% per year, 85% scheduled, 15% unscheduled. This approaches the reliability of a utility system. In 1979, about 5% of the energy delivered to GE was produced from the the two smaller backup oil-fired boilers; the remainder was produced firing solid waste.

Three factors have contributed to RESCO's reliability: 1) a simple design concept with previous operating experience in Europe and Japan, 2) management's willingness to support the project, and 3) the availability of sufficient capital from private enterprise to solve early problems.

Availability

As discussed above, availability of each of the refuse-fired boilers has recently approached 80%. At present, the combined availability of the refuse-to-steam units is nearly 90%. Use of the auxiliary boilers, when necessary, raises overall plant availability even further.

Down Time

In the first two years of operation, down time resulted from various shakedown difficulties, including corrosion and erosion of superheater tubes, air pollution problems, and grate mechanical problems. These have been largely overcome through various modifications, which are discussed in detail below. Down time now occurs primarily when unusual refuse finds its way into the system. A recent example cited by plant pesonnel involved a load of small ceramic balls that jammed in the grate system, forcing a shutdown. The most recent fire in the refuse pit that required fire department attention occurred over a year ago, in 1979.

MODIFICATIONS

Several major modifications were carried out early in the project. These were done to solve problems of grate wear, boiler tube wastage, and air pollution. RESCO staff do not anticipate that further major modifications will be necessary.

Grate Wear

The furnace design is a scale-up of units built by the von Roll Corporation for incineration and heat recovery in Europe and Japan. Refuse from the Boston area differs from the refuse in those regions; American waste has a greater heat value and contains more abrasive material. RESCO management considers detailed information about grate modifications to be proprietary. In broad terms, the grate modifications involved the use of alloys having greater strength at high temperatures.

Boiler Tube Wastage

Boiler tube corrosion became a problem early in the operation of the project, particularly in the superheater where both corrosion and erosion were apparent. The corrosion pro-

cess was greatly slowed by a change in tube metallurgy (after several trials), and the erosion problem was mitigated by better cleaning procedures which minimized slagging and the resultant increased velocities. The overall internal configuration of the combustion chambers was changed to obtain improved combustion and mixing of gases. A further anticorrosion modification was the use of a rapping mechanism, rather than soot blowers, for boiler tube cleaning. The shock from the rapper dislodges most scale and soot but leaves a thin coating which acts to protect the tube.

Air Pollution

Within the first two years of operation, the excessive boiler corrosion, just discussed above, caused RESCO to modify the internal structure of the boiler and to increase air flow through the boiler. Roughly coincident with those modifications, a serious particulate pollution problem began to occur. "Black flakes" were noticed by Saugus residents and were traced to the facility.

In August of 1978, the Massachusetts Department of Environmental Quality Engineering (DEQE) ordered RESCO to limit the amount of waste processed until it could solve the particulate problem. It is possible that the increases in air flow through the boiler contributed to this problem. RESCO proceeded with a staged testing and modification plan that resolved the situation:

1) particulate testing at normal load; established presence of black flakes
2) particulate testing at reduced load; established results of tests and modifications
3) reduced combustion air flow
4) cleaned and adjusted precipitators
5) enlarged ash removal system below hopper to prevent buildup
6) enlarged boiler exit duct
7) sealed precipitator collection hoppers to eliminate back-flow of ash
8) reduced air infiltration into furnaces
9) modified precipitator controls, effectively increasing arc-over voltage
10) modified combustion air control; based control on furnace oxygen level
11) optimized precipitator rapping cycle
12) reduced precipitator rapping intensity.

Other minor modifications were also made during this period.

Baghouse

A small experimental baghouse was fitted to one of the units, accepting a 40,000 CFM side stream of exhaust gas.

Shredder

A shredder intended to reduce bulky waste, installed during plant construction, was decommissioned shortly after startup. One explosion (not major) and several shredder fires caused more difficulty than the unit was worth, in management's opinion.

IMPACT ASSESSMENT AND COMPLIANCE

Air quality, residue disposal, noise, and traffic impacts have been of major concern. These concerns are reflected in the Environmental Impact Report for the plant and in events that have taken place since startup.

Air Quality

The Massachusetts DEQE has responsibility for licensing air emissions sources in the state. Final stack testing had not yet been accomplished when the black flake problem occurred. The DEQE issued an order limiting the amount of waste to be processed by RESCO and requiring immediate correction. Modifications, described above, were performed and the situation was rectified. Particulate emissions stack tests conducted in 1980 showed emissions to be roughly half of the State requirement of 0.05 gr/scf corrected to 12% CO_2.

Residue Disposal

The DEQE does not consider the residue from RESCO to be either a hazardous waste or a "special" waste; it may be landfilled in any disposal site which can accept municipal refuse. RESCO currently stockpiles ash residue on a small portion of the Old DeMatteo landfill. Ash leachate is neither collected nor monitored. The Massachusetts DEQE has permitted this operation as a temporary measure. Saugus is allowing RESCO to use residue as a base cover for the DeMatteo landfill.

The Massachusetts Bureau of Solid Waste Disposal (BSWD), which deals with solid waste management (but not compliance or enforcement) issues around the state, has joined with other concerned state agencies to sponsor a group of studies on RESCO ash residue.

These state-sponsored ash studies include the following subject areas:

- leaching impact and vegetation growth
- landfill final cover
- road construction aggregate.

Study of leaching impact has shown that although RESCO bottom ash contains large amounts of cadmium, lead, chromium, and other metals, these metals do not enter the environment; they are tightly bound to the ash matrix. Despite the acidity of rainfall in the Waltham, Massachusetts, test area (average pH of 4), the buffering capacity of bottom ash is such that leachate pH remains above 7 (neutral) and the movement of heavy metals is minimized. The opinion of the leaching impact researcher is that RESCO bottom ash should be considered a non-hazardous waste.

Performed in conjunction with the leaching research, vegetation growth studies have shown that RESCO residue is a suitable growth medium for grasses, flowering and ornamental plants, and virtually all plant life not requiring a low soil pH. The suitability of RESCO residue as a growth medium for food crops was not addressed.

An experiment is planned by the Massachusetts DEQE in which RESCO residue will be used to provide 18 inches of the final cover at a landfill in Harold Parker State Park. Vegetation growth and groundwater quality studies will then be conducted.

Study of the use of RESCO residue as road construction aggregate began in the summer of 1980. A one-mile length of State Highway 129 was paved using RESCO residue, with a top layer of conventional asphalt. The asphalt cap will protect the residue from contact with rainwater, effectively isolating it from the environment. This experimental pavement will be observed for several years to determine compaction, durability, etc.

RESCO is unwilling to dispose of the residue as yet, pending clarification of whether the material has any economic value.

Noise

Prior to construction, the draft Environmental Impact Report (EIR) for the project was criticized by the Secretary of the Executive Office of Environmental Affairs for insufficient discussion of noise receptors and impacts. This was rectified for the final EIR. However, when operations began, several noise complaints were received. To alleviate some noise generation, RESCO has had to change the location of a steam vent and install mufflers.

Traffic

Because RESCO is located on the former landfill site, a severe traffic impact was not expected and, in fact, has not occurred. In hindsight, however, the Town of Saugus might have benefitted from a clause in the waste supply agreements stipulating that haulers remain on designated roadways when passing through Saugus. Haulers of commercial waste presently are free to take any legal route they choose, and this is a minor nuisance for the Town.

SUCCESSES, FAILURES, REMEDIES

Support From Energy Market

It can be argued that in a situation such as occurred at Saugus, with the landfill exhausted, no replacement available, and an energy market nearby, something very like RESCO was bound to happen. Perhaps that is so, but in the early 1970's very little was known about resource recovery plants, and cities were reluctant to take risks. Without continued encouragement and support from GE in the early stages, an additional delay of two years or more could easily have occurred.

Research and Development Approach

Wheelabrator-Frye perceived this plant as an investment in research and development. The company supplied funds and engineering to solve shakedown difficulties with tube corrosion and air pollution. Wheelabrator realized that, in bringing a European technology to the USA, unanticipated difficulties would arise. Company personnel cite the larger scale of this plant and the different composition of American refuse as fundamental differences between a European and an American operation. They are continuing with the R&D point of view and also see the plant as a training ground; it is now overstaffed with capable operators in anticipation of a second RESCO plant being built somewhere in the nation. The plant is a testing ground as well; its parking lot is paved with "ash-phalt" made from RESCO residue, and a side-stream baghouse is attached to one unit for test purposes. RESCO management feels that future plants will probably use baghouses for air pollution control, and is seeking funding to install a full-size baghouse on one unit.

Air Pollution

The lack of odor from the facility has been a clear success. Combustion air is drawn from within the building; as a result, odors are burned. Particulate emissions did not conform to air pollution regulations at first, but were brought under control by a staged program of plant modifications. When finally tested, the boilers were emitting about one-half of the particulates allowed, which conforms to the original plant design.

Permit Coordination

The coordination of permit approvals for RESCO by the State Bureau of Solid Waste Disposal (BSWD) was an unqualified success. It was a necessity as well. Despite little previous experience in steering a multidisciplinary project through the maze of regulations and permit requirements, the BSWD accomplished the coordination task with minimal delay. The fact that the coordinator was personally acquainted with many staff members in the permitting agencies was critical to this success.

Plant Personnel

Many of the operating personnel at RESCO have been with the project from the beginning. They are well-trained, capable, and clearly take pride in their work. This results from a positive, aggressive attitude on the part of plant management, and is reflected in the tidy appearance of the plant. Although difficult to measure, the reduced cost of plant maintenance resulting from employees' genuine concern for the project is doubtless a factor in the profitability of the enterprise.

Regional Planning

Regional planning was not a success in the RESCO project. Prior to closure of the De Matteo landfill, meetings of representatives of the towns using the landfill went on for months without producing a plan of action. Staff in state solid waste agencies cite this as typical of New England; town governments and the "town meeting" process foster an atmosphere of independence, even rivalry, among communities, rather than a cooperative spirit. The towns did not seek help from state agencies; there was a lack of trust of the state stemming from the governor's 1967 order that the Saugus landfill be reopened in spite of the Town's having shut it down.

Waste Supply

An initial shortfall in waste supply to the plant received some attention at first. On the day RESCO's refuse boilers were first "lit off," the State ordered the De Matteo landfill permanently closed. Without the landfill, the plant had no backup disposal capability for periods of shakedown downtime. As a result during the start-up period, RESCO was unable to contract for more than the capacity of one boiler. The situation had a major influence on revenues for the first two years.

Since then, the plant's profitability has largely overshadowed this issue. Unexpectedly rapid rises in fuel prices have produced high revenues for RESCO; had this not occurred, the continued short supply of waste would still be seen as critical. Some combination of foresight and luck assisted RESCO management in its decision to begin construction before securing the waste supply.

Steam Market

The steam market available to RESCO is adequate for the present, but little expansion is possible, because no other purchasers are located close enough to the plant. If more waste becomes available to the plant, cogeneration of electricity probably will be the method of energy production.

FUTURE DEVELOPMENTS

The most immediate need for the plant is to obtain additional waste delivery to run at the 1,200 TPD capacity. Additional short-term contracts with commercial waste haulers and with other nearby cities and towns are actively being sought. The City of Boston has delivered a portion of its refuse to the plant under such a short-term agreement.

Depending on future demand from GE, the opportunity may exist for RESCO to seek an additional energy customer or, most likely, to cogenerate electricity.

The final disposition of RESCO residue will depend in part on the results of findings from the Massachusetts Bureau of Solid Waste's residue studies. Positive findings from their Route 129 paving study, although several years away, would facilitate sale of the material as aggregate. The residue may also be useful as cover material for landfills.

CHAPTER 5 - THE CALIFORNIA PERSPECTIVE

INTRODUCTION

In this chapter, the RESCO project is examined with respect to its viability as a resource recovery project in California. Particular attention is paid to the issues of ash disposal and air pollution, and to the permitting process.

PROJECT LOCATION

The demographic characteristics of the Saugus area may be found in California, but corresponding geographic conditions do not occur. RESCO is located in a metropolitan area, in one of a group of towns close to a major seacoast city. These characteristics exist in the San Diego, Los Angeles, and San Francisco regions. Two significant geographical differences between Saugus and the West Coast are climate and topography; California's dry season and coastal mountains combine to create air pollution problems not experienced in Massachusetts.

ASH DISPOSAL

The residue handling methods now practiced at the RESCO plant would not be permitted in California, where ash is considered a hazardous waste. Before opening the RESCO plant, ash leachate was tested in a study at Notre Dame University, sponsored by Wheelabrator-Frye. At RESCO, ash is stockpiled on a small portion of the adjacent property (the former landfill), awaiting final disposition. No provision is made for leachate control or monitoring. Permission to store ash in this manner was granted by the DEQE as a temporary measure. RESCO would like to sell this residue as an aggregate construction or paving material. Both RESCO and the Commonwealth of Massachusetts are awaiting the results of various ash use and disposal studies being carried out at the University of Massachusetts' Waltham Field Station and at other locations around the state; the testing program and results to date were described in Chapter 4. The final results will also have serious implications for resource recovery projects in California and the rest of the nation.

AIR POLLUTION

The location of the RESCO plant is presently a non-attainment area for photochemical oxidants; a new facility on the site would be subject to New Source Review rules. This would certainly be the case for a similar facility built in California. To date, the only test results made public by RESCO concern particulate emissions; however, it is evident from discussions with Wheelabrator-Frye staff that California restrictions on other pollutants would cause difficulty for a California project similar to RESCO. Recommendations of the California Air Resources Board (CARB), published in their report, "Air Pollution Aspects of Resource Recovery" are the major cause of concern. The CARB finds that Best Available Control Technology should be required on resource recovery plants now proposed for construction in California; that BACT for particulates is a baghouse which limits emissions to 0.01 gr/dscf; for oxides of sulfur and acid gases, flue gas desulfurization systems with 90% efficiency; for oxides of nitrogen, selective catalytic devices or wet NO_x scrubbers (probable BACT; determination not yet final). The key issue for Wheelaborator-Frye is one of technical and financial risk. In their opinion, baghouses and scrubbers have not been demonstrated as being reliable on a commercial basis for waste-to-energy facilities. As a full-service contractor, Wheelaborator-Frye would have difficulty guaranteeing the removal efficiency and cost impact on tipping fees of these pollution control technologies.

The Massachusetts DEQE is presently evaluating several pollution control devices for the removal of oxides of sulfur and/or nitrogen. These would be placed between the boiler and the electrostatic precipitator (or baghouse). A lime scrubber is one example of such a device.

WASTEWATER

Wastewater from the facility is primarily sewered ash quench overflow; this water originates as boiler blowdown, and as such is high in total dissolved solids. A similar arrangement is likely in a California facility; approval will be dependent on the ability of the local wastewater treatment plant to handle the effluent. Pretreatment at the site may be found necessary for a similar plant in California.

STATE SOLID WASTE MANAGEMENT AGENCY

There are two state agencies directly involved with solid waste management in Massachusetts. The Department of Environmental Quality Engineering (DEQE) is the enforcement and regulatory body under the Executive Office of Environmental Affairs. The DEQE regulates solid waste handling, air emissions, and water emissions. The Bureau of Solid Waste Disposal (BSWD) is a planning and implementation-oriented agency under the Department of Environmental Management. With respect to resource recovery, the Bureau's function in recent years has been to assist groups of communities with the planning and RFP processes. The Bureau coordinated permit approval for the RESCO project.

At the state level, the proponents of a solid-waste-related project in Massachusetts must deal with both the BSWD and various branches of the DEQE. They are located in several offices around the Boston area and in other parts of the state. The BSWD and DEQE are also responsible for hazardous waste management. Personnel changes are frequent, and occasional reorganization compounds the problem of finding the proper contact person. In comparison, the California State Solid Waste Management Board is much less fragmented and is more likely to provide efficient assistance to a resource recovery project.

A complicating factor in California, however, is that there are several state agencies having authority in distinct areas of environmental regulation. In Massachusetts, the equivalents of the Air Resources Board, the Water Resources Board, the Water Quality Control Board, and others are contained within one agency, the state Office of Environmental Affairs.

PERMIT PROCESS

Some details of the RESCO permit process were discussed in Chapter 2. The permitting task for RESCO was similar in size to that for a California facility; i.e., about 30 permits were required at the local, state and federal levels. Permit coordination was necessary, and it worked because the permit coordinator was an experienced state agency staff member, familiar with people in many of the permitting agencies. This factor is worth noting by permit coordinating bodies in other states.

Another point stressed by the permit coordinator for the RESCO plant is that permits and permit applications should remain general, referencing plans and specifications but not incorporating elements of plant design into the permit itself. This permits flexibility if designs must be changed or finalized during construction.

FINANCING

Industrial development bonds are bonds issued by a public entity for the benefit of a private corporation. Such bonds are secured by payments made to the issuer by the private corporation and, therefore, the interest rates on them are dependent upon the creditworthiness of the corporation itself.

In California, the only entity empowered to issue such bonds in amounts greater than $10 million is the California Pollution Control Financing Authority (CPCFA). The CPCFA was created by the Legislature in 1973 and is governed by the California Pollution Control Financing Authority Act. As resource recovery projects are regarded as pollution control facilities under Internal Revenue Service Regulations, they are eligible for revenue bond financing under the CPCFA's program. Resource recovery facilities must convert wastes to a useful form of materials or energy only as a means of waste disposal. Such projects must be certified by the Solid Waste Management Board as necessary, as conforming to county plans, as furthering environmental objectives, and as having solid waste disposal as the primary project function.

In California, CPCFA financing could be used in a manner analogous to the issuance of industrial development bonds by Saugus. For Saugus, special legislation allowed the city to issue those bonds without affecting its indebtedness limit.

In California, cities and counties have the right under the California Industrial Development Financing Act to establish an industrial development authority and to issue revenue bonds to finance privately-owned projects. These bonds are tax-exempt. The law, however, restricts the issuance of industrial development bonds in amount to no more than $10 million. All of the usual industrial bond provisions are included in the Act. The $10 million available through this source is definitely not sufficient to fund a major project unless there is a very large contribution from another source such as private equity.

The leverage-lease financing arrangements made for the RESCO plant would work in California; however, the increased sophistication of the resource recovery bond market over the last five years would require that a supply of waste be secured before the bonds are issued.

OTHER CONSIDERATIONS

Local Citizen Use

Saugus area residents do not personally deliver much waste to the RESCO plant. In part, this occurs because the amount of waste disposal at curbside is unrestricted. California residents generally make greater use of landfills, and the design of a RESCO-type facility would have to take this into account.

Waste Composition

The waste collected in California municipalities is probably little different from that delivered to RESCO, except that yard waste would show a less extreme seasonal variation in a West Coast city.

Waste Control

RESCO has signed long-term contracts for about half of the refuse it needs. The rest is delivered by commercial haulers with short-term contracts. The short-term haulers would be free to choose another waste disposal site, if an alternative existed in the Saugus area. In California, the fact that landfill space is more available would necessitate stronger waste control measures for a RESCO-type project, either in the form of contracts with franchisees specifying the disposal site or as legal measures (waste control ordinances).

The long-term waste supply contracts stipulate that the towns supplying waste to RESCO may increase or decrease their delivery by 10% per year without penalty. This gives the communities leeway to institute recycling programs. In California, where local support and participation in recycling programs is strong, similar provisions in waste supply contracts are likely.

Site Visits

Prior to construction, the North Shore Waste Disposal District members visited a similar facility in Montreal; this visit was paid for by the DeMatteo company. The familiarity gained in even one site visit was an asset when bargaining began between the communities and RESCO. California project proponents would have a great deal to gain from similar exposure.

CHAPTER 6 - PROJECT EVALUATION

PROJECT BENEFITS

The most obvious benefit from the RESCO plant is the elimination of a nuisance landfill. The DeMatteo landfill had been picketed, shut down, reopened by the state governor, and finally closed by court order in 1975. An environmental study showed that any extension of the landfill would increase the adverse effects on the bordering estuary.

General Electric realized clear savings in oil consumption and capital investment. Roughly 425,000 barrels of oil per year are saved by GE's use of RESCO steam. GE also did not have to construct two new boilers in 1974-75; their replacement cost would have been $4.5 million in 1973.

Wheelabrator-Frye and its licensor, von Roll, benefited from the opportunity to develop a large scale version of the von Roll system for the American market. Improvements in boiler controls, air pollution control, boiler and furnace design, and experience in refuse handling are all "selling points" for future Wheelabrator/von Roll systems.

PROJECT-RELATED PROBLEMS

Ash disposal is the major problem facing the project. The final value of RESCO residue may be positive or negative depending on the findings of several residue studies. Disposal of the ash as a special or hazardous waste would severely impact project economics.

Other problems, such as traffic through the Town of Saugus, are relatively minor.

UNEXPLOITED OPPORTUNITIES

The Public Utility Regulatory Policies of 1978 requires that utilities purchase power from small cogeneration facilities. RESCO could install a third boiler and produce electric power if refuse were available. The City of Boston is an obvious source of refuse, and it is considering various alternatives for solid waste disposal. Boston may choose to send some waste to RESCO or to route all of its waste through a separate facility.

Co-disposal of sewage sludge at RESCO has been considered in the past and may be reconsidered. A large wastewater treatment plant handling effluent from Saugus and Lynn is presently nearing completion in Lynn. Earlier, combustion of scum from a local treatment plant was considered but was dropped when a less expensive land disposal method was found. Sludge from the Town of Salem has been considered but was found to be too high in chromium; the Town of Saugus would not permit combustion of the material.

HINDSIGHT EVALUATION

Different parties to the RESCO project perceive different aspects of the project that they would change, if given the opportunity to "start from scratch."

Wheelabrator-Frye staff cite a number of technological improvements that would be built into the next such facility. The combustion chamber design and boiler control systems would reflect improvements made in the RESCO plant. The grate system would be designed for easier maintenance and would probably consist of a single large grate instead of three grates with steps in between. New metallurgy and ceramic materials would be used where appropriate. The economics of baghouses as the principal air

pollution control device would be more closely evaluated. To limit dust, the tipping area would be more completely enclosed. A shredder for bulky waste would be omitted from the design.

At present, some low-pressure steam is returned from GE to RESCO. Given the chance to start over, RESCO would prefer not to purchase return steam from its customer, but rather, would simply use the steam in-house for deaeration, feedwater heating, and to drive rotating equipment.

The Health Officer for the Town of Saugus would change other aspects of the plant. He would prefer that the plant be totally enclosed, both for the sake of appearance and to better control windblown litter. Review of the design by participating communities was not done for the RESCO plant, but it would be required now. The problem of traffic through Saugus could be resolved if waste supply agreements with all haulers restricted their traffic to certain routes.

It is noteworthy that, in interviews, none of the parties to the RESCO project mentioned MITRE Corporation's impartial evaluation/fact-finding activity as something that should have been eliminated or done differently. No other consultant was hired by the communities involved.

APPENDIX A - FIELD INSPECTION NOTES

GENERAL QUESTIONS

- Background: What was the problem that provided impetus?

  impending closure of DeMatteo landfill
  General Electric's energy requirement

- Benefits of the project?

  slight reduction in number of waste vehicles used, due to short turnaround time
  replacement of objectionable landfill with industrial facility
  cheaper energy, reduced oil imports for GE
  resource recovery state-of-the-art advanced
  tax revenue to Saugus

- Does it solve the problem?

  yes - both problems

- Does it cause any other problems?

  disposal of residue
  traffic through Saugus

- If the same project were begun today, what would differ?

  towns would participate more in design or design approval
  waste supply would be secured prior to financing
  Saugus would limit commercial-hauler traffic on side streets
  design changes: improved grate, more sophisticated combustion air control, altered shape of furnace interior

- Role of State Solid Waste Agency?

  DEQE: issue air emissions permits
  BSWD: permit coordination, co-sponsor residue test program

- Local governments - how cooperative?

  towns could not agree on regional approach; went with RESCO because no other alternative existed; had MITRE confirm that RESCO's profit margin was not unreasonable

- Waste Supply - how obtained?

  supply contracts with surrounding communities (long-term), outlying communities (short-term), and private disposal operations (short-term)
  long-term contractees pay penalty if waste supply varies by more than 10%/year

- Unexploited opportunities for energy/material recovery?

  if waste supply increases, cogeneration is an option
  only materials recovery at present is ferrous metal

- Critical factors in development of the plant.

  Obstacles: permit approval procedures
  citizen objection to noise, "black flake" emissions
  breakdown of original DeMatteo/CE joint venture (THESCO)

  Boosts: legislation to permit revenue bond financing by towns without encroaching on indebtedness limit
  citizens saw RESCO as preferable alternative to existing landfill
  equity investment by joint venture partners was over $20 million

PLANNING - STUDIES

1) Title	By	Fund Source
initial feasibility study (exact title unknown)	Metcalf & Eddy	General Electric
Feasibility Study (for THESCO)	CE Maguire/Comb Eng	DeMatteo
Feasibility Study (for prospectus)	R. W. Beck	RESCO
Technical and Economic Information....	MITRE	RESCO and nine communities

2) Alternatives Investigated

Continued Landfill
Mass Burning
RDF/Dedicated Boiler
Co-Disposal w/Sludge

3) Wastes Considered

Type	TPY	Avg. TPD
MSW	438000	1200

4) Technology Recommended: Mass Burning

Reason: experience gained in Europe; overall life-cycle cost was lower than for RDF (though RDF was lower initial investment)

5) Future Considerations

2-5 years

Waste Increase: will probably reach plant capacity

Disposal Methods: continue to use present system

5-15 years

Waste Increase: depending on long term plan for City of Boston, delivery to RESCO could increase dramatically

Disposal Methods: if large increase, install third furnace/boiler

PLANNING - GENERAL

1) Risk Allocation

Type of Risk	Entity Assuming Risk	How Assumed
Waste Supply	RESCO	contracts with haulers
Energy Market	RESCO	contract with GE
Disposal of Residuals	RESCO	must comply with DEQE
Facility Construction	RESCO	WFI/Rust Engineering
Facility Operation	RESCO	contracts stipulate waste must be taken; if steam not produced, GE receives payment
Debt Service	Saugus/RESCO	trustee receives lease payments from RESCO; if default, City may remedy

2) Impetus

Disposal Problem
Energy Demand

3) Citizen Participation

Committees (formed or existing)
nine communities and GE (informal committee)
local environmental organizations acted as watchdogs

Local governments involved
Saugus, Lynn, Malden, others (see Chapter 1)

Public Meetings: Number, Sponsor, Purpose
many town meetings to inform and receive comments from local populace
required public hearings for permit approvals

Citizen Complaints

noise (just prior to start of operations) due to steam venting
particulate emissions ("black flake" problem) in mid 1978

4) Recycling Programs - Prior, Existing and Planned

former programs, in Saugus and elsewhere nearby, failed for lack of participation and/or inadequate markets
no new programs planned

5) Anticipated Effect of Recycling Program on Energy or Material Recovery

not applicable

6) Site Selection

Procedure: DeMatteo provided most of land; GE sold an adjoining parcel to RESCO

Public Involvement: rezoning hearings at town meeting

Barriers: minimal

OPERATION

1) Feedstock

Composition
values used from other local studies

Heat Value
4,500 BTU/lb

2) Throughput

Design
Actual

1200 TPD
can exceed 750 tons per unit (two units in plant)

3) Energy Output (note variability)

Availability: approx. 80%

Steam: up to 370,000 lb/hr, at 650 psig, 825°F

4) Materials Outputs

Type	Flow Rate (TPD) Design	Actual
Scrap metal TPD	80 TPD	60-80

5) Residuals (indicate point of removal from process flow)

Type	Flow Rate	Disposal Cost	Distance to Disposal Pt.
ash residue	250 TPD		stored temporarily on site

6) Plant Energy Use

From Internal Sources: none

From External Sources: feedwater deaeration and preheat from return steam supplied by GE; rotating equipment driven by electric power; total internal use approximately 65 kwh/ton processed

7) Process Flow (corrected diagram; attach)

see Figure 2-1

8) Modifications

Completed: grate and superheater metallurgy changed; combustion chamber geometry changed; combustion air control system modified to minimize excess air; precipitator operation improved; experimental sidestream baghouse installed; bulky waste shredder removed

In Progress: none

Planned: none in short term; addition of third boiler if necessary

9) Maintenance

Requirement	Interval
Furnace/Boiler inspection & maintenance	several times per year
Grapple Cranes	as needed (frequent; can be once per week or more)

10) Traffic

Specific traffic count data not available; 6-8 bays available; queue rarely exceeds 6 - 7 vehicles; general public use is permitted but relatively rare

FINANCE

1) Project Initial Cost see Table 3-1

2) Annual Operating Costs proprietary

3) Annual Revenues proprietary

4) Financing

Amount	Type*	Term (Dates)	% Construction / % Non-Construct.
$30 million	ind dev	20 yr	_____

Reasons for Choices

most cost-effective means available

Preparation Entities	Firm(s)	Cost	Time (Dates)
Financing Consultant	White Weld		
Bond Counsel	Ropes & Gray		
Underwriter	White Weld		
Prospectus	White Weld		

Cash Flow Projection see Table 3-2

Plant Life: 20 yr

Salvage Value: none assumed

5) Funds Spent Prior to Releasing Bonds

Item	Origin of Funds
75% of construction cost	RESCO (WFI & DeMatteo)
Feasibility Studies	GE and others

6) Acquisition Approach: Full Service

7) Markets

Steam: General Electric, at avoided production cost less 10%
Ash: no market yet

* GO, Rev, Lease/Rev, IDB, Lev. Lease, other

8) Tipping Fee

Prior tipping cost to Saugus was $0 at landfill; for other towns, several dollars per ton

Tipping fee for Saugus now $15.47/ton (Sept 1980)

9) Method of Charging Disposal Cost to Users

tipping fee per ton

10) Waste Supply Agreements

Descriptions	Supplier	Dates
MSW	Saugus	thru 1995
"	Chelsea	"
"	Everett	"
"	Malden	"
"	Medford	"
"	Melrose	"
"	Nahant	?
"	Revere	thru 1995
"	Stoneham	"
"	Swampscott	thru 1985
"	Wakefield	thru 1995
"	Winthrop	"
"	Lynn	thru 1999
"	Boston	1982
"	Somerville	thru 1995

PERSONNEL

1) Operating Crew (3 Shifts per Day, 7 Days per Week)

2) Maintenance Crew (1 Shifts per Day, 5 Days per Week)

3) Support Personnel (1 Shifts per Day, 5 Days per Week)

4) Training Program

Each worker trained in four different duties
On-the-job, supplemented with "exchange student" program with other power plants

5) Background of Management

6) Safety Record

no serious accidents since startup

Shredder Performance; Other Potentially Hazardous Equipment
one shredder explosion (not major); shredder subsequently removed

7) Union(s)

employees are non-union

ENVIRONMENTAL CONSIDERATIONS

1) Permits (Loc., St., Fed.)

see Table 1-2

Starting Date for First Permit: May 8, 1973 (Town of Saugus Board of Health; site assignment)

Completion/Renewal Date for Last Permit: final permit to dispose of ash residue still pending

2) Exhaust Gas

Source	Control Measures
main stack	electrostatic precip
reserve boiler	none (low sulfur fuel used)

Pollutant Concentration Data

	Source A
Particulates	0.025 gr/scf
NO_x	
SO_x	
CO	not reported
Pb	
Other	

3) Wastewater

wastewater originates as quench tank overflow; tested, approved for municipal sewer, October 15, 1973

4) Noise Measurements (Interior & Exterior)

Location	dBA	Comment
exterior	10 dBA	(above background)
interior		complies with OSHA

5) Odor

not a problem; plant air used for combustion air

6) Aesthetics

appearance acceptable for industrial plant, could be made more attractive

APPENDIX B - BIBLIOGRAPHY

ARTICLES

Conference of Mayors booklet
Resource Recovery and Conservation
Solid Waste Management Magazine, October 1978
"Riches From Urban Trash," 5 Nov 79, San Francisco Chronicle
"State Would Use Parker Forest . . ."
"RESCO Faces Shutdown," 13 Nov 75

MAPS

Boston area map

STUDIES

"Refuse Energy Systems Company Project . . ." DSI preliminary draft
"Refuse Energy Systems Company Project . . ." as Chapter 3, EPA report
"Technical and Economic Information . . ." MITRE, May 1974

PROPOSALS

none

PLANS/SPECIFICATIONS

none

EIR/EIS

Final EIR
Statement of Secretary of Environmental Affairs on Draft EIR
Review of Draft EIR
Draft EIR on . . . Saugus Sanitary Landfill

PERMITS AND REGULATIONS

Environmental Affairs Office, Table of Organization
Policy and Procedures Manual for Solid Waste Program Activities
Regulating the Assignment of Sites for . . . Disposal Facilities
Disposal of Solid Wastes by Sanitary Landfill (regulations)
Installation, Operation and Maintenance of Solid Waste Transfer Stations (regulations)
RESCO Residue Program Review and Update
Residue disposal: correspondence, etc.
descriptive brochure of DEQE
table of permits and approvals required
Particulate emissions - permits, plans, correspondence, recent testing

PROSPECTUS

Town of Saugus, $30,000,000 industrial revenue bond
Wheelabrator-Frye 1979 annual report

LETTERS OF INTEREST

none

CONTRACTS

list of municipalities with RESCO contracts

GRANT APPLICATIONS & GRANTS

none

OTHER

Mr. William Siderewicz, personal correspondence

ANNOTATED BIBLIOGRAPHY

U.S. Conference of Mayors, Institute for the Development of The Urban Arts and Sciences, "Saugus: A Case Study of Economic Development and Resource Recovery," March, 1980.

This 12-page booklet provides a concise description of the history of the RESCO project, with emphasis on political and economic aspects. Technology used at RESCO and the difficulties faced in complying with environmental restrictions are mentioned briefly with little detail. For the nontechnical reader, this is a good general summary.

Solid Waste Management Magazine, "RESCO's Saugus plant pioneers solid waste-to-steam approach," October, 1978.

Technology employed at the RESCO plant is emphasized in this four-page article, written primarily from the plant operator's point of view. Early modifications to the plant are also briefly discussed.

Development Sciences, Inc. "The Refuse Energy Systems Company Project In Saugus, Massachusetts: Preliminary Draft Report," (DSI 0372, 1976).

This case study, written in 1976, is directed at parties considering implementation of a resource recovery project. A general description of the project discusses the technology, principal parties involved, financing and contracts. Each of the contracts between RESCO and other parties is described in considerable detail. A detailed history of the implementation process describes the motives of General Electric, De Matteo and others, and the regulatory forces and energy needs which drove the project along. Negotiations between RESCO and towns supplying waste are also described. Permit coordination by the Commonwealth of Massachusetts is noted. The report concludes with a series of observations of features unique to this project.

The MITRE Corporation, "Technical and Economic Information Relating to the RESCO Refuse-to-Energy Facility and the Refuse Disposal Requirements of Nine Communities" (MTR-2817), prepared for RESCO and nine communities, May, 1974.

This report was written to assess the validity of RESCO's proposed tipping fee, to be charged to nine communities delivering waste to the plant. A thorough and detailed analysis of system economics is given, and results of a survey of the nine communities' waste collection and disposal practices are presented. MITRE found a 7% return on investment and a payback period of about 10.4 years, comparable with other industries of similar size.

Rust Engineering Company and M. De Matteo Construction Company, "Final Environmental Impact Report," July, 1975.

The EIR begins with descriptions of the site and the plant design. Air pollution background information, together with proposed control measures and effects; noise and noise controls; ash residue; traffic; and responses to comments are

included. The lengthy treatments of air pollution, noise generation and ash disposal give an indication of the concern with those issues prior to construction. Overall, this document suffers from disorganized presentation due to the many revisions that were made.

Commonwealth of Massachusetts, Executive Office of Environmental Affairs, "Statement of the Secretary on Draft Environmental Impact Report," April, 1975.

The Secretary draws heavily from a review by the Institute for Man and Environment which is included with the Statement. Concerns expressed by the Secretary include the likelihood of pollution of surrounding tidal waters, air pollution caused by ash handling, the ash disposal problem, and noise emissions and abatement.

Commonwealth of Massachusetts, Departments of Natural Resources, Public Health and Public Works, and the MITRE Corporation, "Draft Environmental Impact Report on Expansion, Operation and Completion of Saugus Sanitary Landfill" (MTR-2955), December, 1974.

In 1974, the Saugus landfill had approximately one year of life remaining. The Commonwealth of Massachusetts, recognizing that expansion of the landfill into adjacent salt marsh could be necessary if RESCO did not open as scheduled (October, 1975), quickly prepared this EIR with assistance from MITRE Corporation. Several on-site alternatives to major landfill expansion were examined; none of them offered more than an additional year of disposal. Impacts of any alternative were forecasted to be substantial.

RESCO, "RESCO Residue Program Review and Update," August, 1980.

This document summarizes findings and activities in each of the several research projects using RESCO ash: 1) Route 129 Project - use of ash to partially replace aggregate in asphalt paving; 2) Horticultural Applications - research at the University of Massachusetts on the effects of residue and its leachate on vegetation, soil and groundwater; 3) Parker State Park - use of fly ash and bottom ash as final cover for landfill. Continuation of these projects and other activities, such as residue composition analysis, are recommended.

Air Quality Consultants, Inc., "Particulate Emissions Test Report, Unit No. 1, RESCO Facility, Saugus, Massachusetts," prepared for Refuse Energy Systems Company, March, 26, 1980.

Data and results from the particulate emissions test of RESCO Unit 1 are reported. During three test runs, particulate emissions were found to be well below the 0.05 grains per dry standard cubic foot limitation established by the Massachusetts Department of Environmental Quality Engineering.

A previous test had found Unit 2 also to be in compliance.

White, Weld and Company, "Prospectus: Town of Saugus, Massachusetts - Solid Waste Disposal Revenue Bonds," June 1, 1975.

This prospectus describes a $30 million tax-exempt industrial development bond issued for three purposes: 1) to refund a previous $15.5 million issue; 2) to repay loans of $8.6 million for construction; and 3) to provide funds for facility completion. Exhibits in the prospectus summarize the plant location, solid waste disposal in nearby communities, estimated costs, permits, and 20-year projected cash flow and balance sheets. The RESCO Corporation is described in detail. Wheelabrator-Frye and its subsidiaries are also described. The prospectus includes an independent evaluation of the RESCO project by R.W. Beck and Associates.

In an update published October 4, 1977, White Weld provides some operating history, including the amounts of postconstruction investment by the owners.